

VI.—*The Platycercine Parrots of Australia: a Study in Colour-change.* By GREGORY M. MATHEWS.

(Plate III. and Text-figures 1, 2.)

THE Broad-tailed Parrots of Australia, ranged under the genera *Platycercus* and *Barnardius*, provide an interesting study in colour-evolution, and close investigation at some later period may lead to valuable conclusions as to the rate and reason of colour-changes. It was necessary to examine the group as a whole and also individually for my 'Birds of Australia,' and in that work I have proposed some theories to account for the facts. I propose to give a *résumé* of my remarks in this place, as this Journal will circulate among a larger and more varied number of readers. I hope that the matter here provided may interest, and perhaps suggest similar criticism of other groups. By means of the co-operation and consideration of independent ideas we may be able to determine some of the factors in bird-evolution, but the complexity of these factors is well shown in the present subject.

In the first place, the Broad-tails are divisible by means of colour-pattern into two genera, *Platycercus* and *Barnardius*. By acceptance of structural characters alone the two are inadmissible. I hope to prove that the former solution agrees best with the facts. The first genus, *Platycercus*, is characterized by having the feathers of the back bicoloured, a broad edging giving the well-known scalloped appearance to that feature. The species of the second genus, *Barnardius*, have the feathers of the back unicoloured. As the young of the first genus show the scalloping to a greater or less extent, it is obviously an ancient feature. As it is missing in the immature of the second genus, we have two stocks divergent at an early period of their existence, though at the present time their structural characters are to all intents identical. Newer and more accurate modes of examination may perhaps discount this last statement.

In the genus *Platycercus* I admit seven species, and in

the genus *Barnardius* I recognize two. Other workers have acknowledged many more species; but I regard these forms as subspecies only, my most recent criticism recording between twenty-five and thirty subspecific forms. Before I undertake the consideration of these I would remark upon some remarkable features of the members of the genus *Platycercus*. Though the species are now well established, and in many cases the subspecies are also fixed, there is a peculiar plasticity seen in the group—albinos, aberration, and hybrids constantly occurring. Further, there has been recorded, more than once, what is apparently dimorphism in the immature stage: that is, the immature taking on the adult plumage in the nest, though the immature plumage is different from that of the adult.

The whole group is confined to Australia, no member ranging into New Guinea or the islands to the north, nor are the species represented there by any form at all comparable.

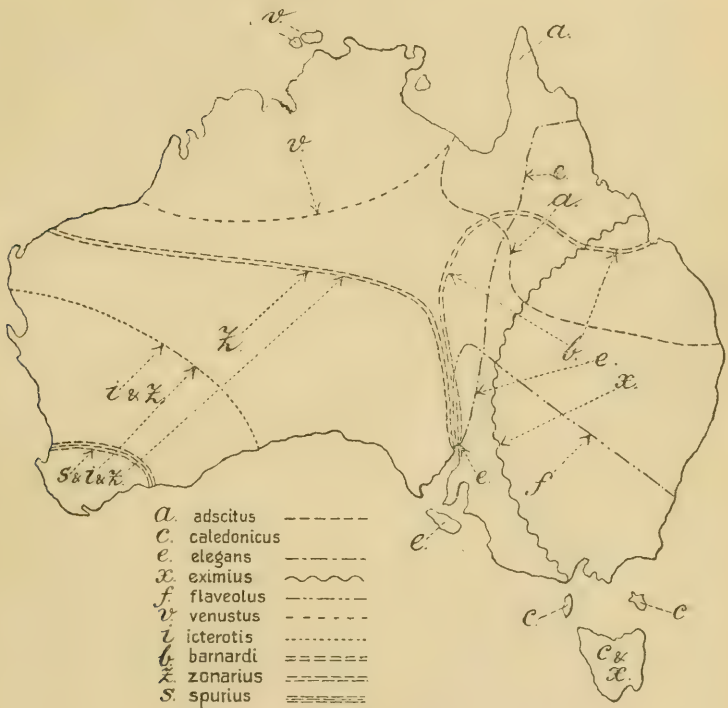
Two species of the genus *Platycercus* occur in Tasmania, and these well merit special consideration, as one is the least developed and the other the most developed, as regards coloration as distinct from colour-pattern. It might be further noticed that in the extreme south-west a species has developed from the *Barnardius* group a structural feature which long ago claimed generic rank (*Purpureicephalus*), and this will be dealt with towards the end of these remarks.

As we have here a peculiar well-marked group isolated in Australia, we are given factors which are not interfered with by extra-limital and unknown complications. Some workers have in other Continents ranked as subspecies forms which were really representative species. In many cases the difference between a subspecies and a representative species is difficult to determine, and a great deal is left to the personal equation. In the peculiar case now before us, I can show that while we have species representing each other we have also subspecies, and in this instance these are well-marked groups of different value.

In the genus *Platycercus* I admit seven species, viz.: *caledonicus*, *elegans*, *flaveolus*, *icterotis*, *adscitus*, *venustus*, and *eximius* (see Pl. III.). While the first six are more

or less representative species, the seventh, *eximius*, ranges coincidentally with *elegans* and *caledonicus*. The ranges of *flaveolus* and *elegans* overlap (see Text-figure 1), as do the ranges of *elegans* and *adscitus*, the *flaveolus* in the southern limits of the range of *elegans*, the *adscitus* in the northern

Text-figure 1.



Diagrammatic map of Australia and Tasmania to show the distribution of the Platycercine Parrots.

extent, but in each case *elegans* strongly survives well into the territory of the other species.

The two species of the genus *Barnardius* cover the southern part of the Continent, being purely representative species scarcely above the rank of subspecies, as will be shown later. The eastern representative does not range into Tasmania.

From a consideration of all the plumage-changes of the

species it is deduced that the ancestral coloration was an unmottled green. The nearest approach to this coloration is seen in the species *caledonicus*, which in the immature has the greater part of the plumage of that colour. To follow the explanation hereafter, it had better be recorded that there is a distinct cheek-patch which is usually blue, in some cases blue and white, in others white, and in one case yellow. This is an easy feature to group the species by, and we can note its direct evolution from a non-differentiated cheek, as the immature of *caledonicus* shows this cheek-patch of quite an undecided blue, partly greenish. The most highly developed species, *eximius*, has a white cheek-patch distinct in the young. The yellow-cheeked species is a peculiar one in many respects, showing plasticity and variable adult coloration. It appears to be developing in two phases under the stresses of different western environments from an all-green immature similar to that of *caledonicus*. We may conclude that the yellow cheeks have developed independently of the blue, though it seems that the white are a later product through the blue. Thus the northern species have the cheeks mixed white and blue, the white apparently being produced at the expense of the blue. Further, this elimination of blue cheeks is accompanied by an albinistic tendency in one species, but in the other by a complex melanism. Hence we cannot deduce much from the variation of one feature only. However, by the consideration of all the features we may arrive at some valuable result, and consequently it is necessary to lay some stress upon apparently trivial points.

The colour that is present in every species is red, so that we may suggest an erythristic element in the original species, the ancestor of *caledonicus*. It has predominated in the species *elegans*, become lessened in *flaveolus*, only surviving in the under tail-coverts of the northern species *adscitus* and *venustus*; in the species *eximius* it has developed coincidentally with a yellow coloration, while in the western form *icterotis* it is now in a most interesting stage. Thus the coastal form appears to be mostly green on the back, though the under surface is red in the adult. In the interior the green back



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PARROTS.

H. Grönvold, del.

is becoming grey, and red tips are making their appearance on the feathers, and it seems that this grey stage is becoming fixed in the immature.

However, I had better place the facts of the coloration on record and discuss their suggested evolution afterwards. I will begin at *caledonicus* (Pl. III. fig. 1), as I believe it to be nearest the ancestral form. This species has a greenish coloration throughout, darker on the back and yellowish green below. A red frontal patch appears and the cheeks have a bluish tinge, and there is a faint bluish shoulder-patch. These are present in the young, but are indistinctly marked and can certainly be regarded as a comparatively recent acquisition. They become emphasized in the adult while otherwise the head and under surface develop more brightly into greenish yellow, the feathers of the back becoming black with, however, bright green edges, giving a scalloped appearance.

It is noteworthy that Tasmania is the home of this form. On the mainland two species seem to have evolved independently: *flaveolus* (Pl. III. fig. 3) has retained the coloration throughout, but has brightened on the under surface to pale yellow, and also the upper surface to the same colour, retaining the black bases to the back feathers. The upper surface of the tail has, however, become blue. The other species, *elegans* (fig. 2), has in the juvenile stage evolved a reddish cap, and the breast and vent have also attained that colour, the belly remaining greenish. The mature, however, has become a scarlet bird, the whole of the upper and under surfaces being that colour, though the bases of the back-feathers are black, while the upper surface of the tail is blue. The scarlet coloration is much deeper at the limits of its range, but in one district the scarlet has become orange and the bird has been confused with the preceding species.

The fourth species, *icterotis* (Pl. III. fig. 7), when immature recalls that of *caledonicus*, but has no red forehead, and the cheeks are yellowish not bluish. This species develops yellow cheeks, all the preceding species having blue cheeks, while it also acquires a red under surface. As regards the upper surface two phases are in being, one in which green still

predominates, as in the edging of the back-feathers, the rump, and the upper surface of the tail; the other in which the upper surface is greyer, that being the colour of the rump and the edging of the back-feathers, which, however, in quite old specimens is replaced by scarlet tips, while then the upper surface of the tail becomes blue. This is the sole south-western species. A north-eastern and a north-western species, *adscitus* (fig. 4) and *venustus* (fig. 8), agree in showing pale yellow backs with the cheeks parti-coloured, but otherwise are remarkably different in that one tends to albinism and the other to melanism, using these words in a specific sense. The albinistic *adscitus* has the head and back pale yellow, in the former place tending to white and extending on to the throat. The yellow of the back only refers, of course, to the broad edges, the bases being as usual black; the rump is of a different colour, varying from grey to blue, while the underparts are bluish, differing in localities from greyish to greenish blue. This species is of remarkable coloration, but is as peculiar for its instability, almost every mature specimen showing variation in extent and depth of the yellow coloration. It appears, however, to have passed the green stage in the immature, young birds showing a similar but duller coloration to the mature, with the head, however, speckled with blackish tips.

The north-western species, *P. venustus*, has the head black, the back black with yellow edges, the rump and under surface yellow, the feathers tipped with black, while the bases are black. The cheeks are parti-coloured blue and white, and the tail is blue. This species, again, has passed the green immature stage, as the young are quite like the adults.

The last species, *P. eximius* (fig. 5), has perhaps the most beautiful coloration of the series, and the specific name seems well chosen. The head and breast are bright scarlet, the lower breast golden-yellow, the abdomen green, and the under tail-coverts scarlet; the cheeks white; the black back scalloped with golden-green, the rump yellowish green, and the two middle tail-feathers green, the rest dull blue. The species occurs in the east from New South Wales to Tasmania.

I have considered these species as a whole, and now suggest the probable dispersion and evolution of the forms.

I propose to allow a northern origin for the group, and I conclude that the ancestral form was purely green. In the germ-plasm we may assume there was a yellow element, a blue element, and a red element.

The blue element shows itself in the blue cheeks, blue shoulder-patch, and generally blue tail. The yellow element is seen in the two northern species in full play, subdued in the eastern species, and almost entirely missing in the western.

The red element is noticeable in all save the two northern species, where, however, it crops up erratically in the north-western form.

The varying dominance of these elements has constituted the species, but the exact stresses are at present unknown, and the excitation of interest in the search of these is the purpose of this note.

Thus the geographical distribution of the species admits of theories of evolution without giving clues to the stresses, while these cannot be suggested from knowledge of their environment.

First, we may suppose that the green bird entered Australia by way of Cape York, and travelled down the east coast into Tasmania, and along the south coast into south-west Australia. It is probable that the central and north-western parts of Australia were submerged or separated. Tasmania became isolated, so did south-western Australia, the latter division not remaining permanent as did the former. The stress in both cases was towards the preservation of the green coloration, but the erythristic element shows itself in the red forehead, the xanthochroistic in the head and under surface, the cyanistic in the cheeks and shoulder-patch in the Tasmanian form; while in the south-west species the xanthochroistic has been suppressed in favour of the erythristic, it in its turn eliminating the cyanistic in the cheeks. We thus see a yellow-cheeked species with, however, the blue shoulder-patch, while the yellowish under surface has become dull red. Since this stage was achieved a further development seems to be

taking place by the revival of the cyanistic element, and this has caused the back-feathers by interaction with the erythristic element to become grey, while the blue tail-feathers come into their own as seen in the eastern forms. Then still the erythristic element is working, and we find the grey eliminated in favour of red. All these stages can be seen at once in a series from the west, and, moreover, it appears that the grey phase is becoming the juvenile plumage and the red the adult, the immature green of the coast being lost; further, on the coast the green is more or less perpetual, the back and tail-feathers remaining in that colour. We can guess that the climatic conditions in these cases favour the changes denoted, but in other parts of Australia similar climatic conditions are associated with entirely different coloration.

To return to the Tasmanian form; on the islands of Bass Straits we find it varying, being constantly darker, but in one case larger, in the other smaller, while in the one it has red under tail-coverts, in the other green. No reason for this variation can be suggested at the present time. On the mainland, as regards the south three species occur: one is the mainland representative of the Tasmanian species in which the xanthochroistic element has maintained itself, and the bird has become practically wholly yellow, the blue cheeks, blue shoulder-patch, blue (upper) tail-feathers, and red forehead being unchanged. It has varied only in the depth of the yellow.

The second is the erythristic form of the group, and this is the dominant species, so far as can be ascertained, in eastern Australia. Commencing life with a red cap, red breast and vent, blue cheeks and shoulder-patch, otherwise all green, it has developed all the head and under surface scarlet, the edges of the feathers of the back scarlet, the tail blue above, the blue cheek and blue shoulder-patch persistent; it will be noted that the xanthochroistic element has been entirely suppressed, though the cyanistic has maintained its usual standard. Variation in this species is notable and interesting. At the extremities of its range, it has become smaller and melanistic, while it is suggested that

at one (the southern) limit it takes on its mature plumage, if not from the nest, at least very soon afterwards. In other parts of its range, immature specimens are much more plentiful than adults, and it is recorded that they commonly breed in the immature plumage. Kwartland concludes that males do not take on the mature plumage until two years old, and that females continue in the immature state much longer. There are further notes that sometimes the young in the nest are plumaged as the adult, but more evidence of this is required. However, at the eastern limit, and geographically not very distant from the southern end of its range, the xanthochroistic element has regained strength and the scarlet has become orange. This has continued in some cases so that fully adult birds have been mistaken for the xanthochroistic species living close by. We have here a representative species and a representative subspecies very closely approaching each other, through the revival of the dominating element.

Thirdly, coincident with these species is a third, in which the erythristic and xanthochroistic elements have developed without interference, though the cyanistic has been suppressed. In this species the cheeks are white, the head and breast scarlet, lower breast golden yellow, abdomen green, under tail-coverts scarlet; the back scalloped with golden-green, rump yellowish green, and tail green.

Little variation is seen in this species, which ranges into Tasmania. The most important point is that it seems to be getting brighter-coloured, and is increasing owing to the destruction of bush, it having been christened "a bird of sunshine." We may conclude that here the xanthochroistic element is developed under sunlight, but this would not account for the yellow cheeks of the western form nor the yellowish underparts of the Tasmanian species (*caledonicus*), while this species (*eximius*) ranges into Tasmania and the yellow becomes more green. So far as I can discover, the immature take on the mature plumage from the nest, proving that this is the most specialized of the southern species.

The two northern species can be treated together, as they have many peculiarities in common; in both the immature

green plumage has been lost, in both erythrism is missing, in both xanthochroism is dominant, but in the one case cyanism is a strong factor, in the other melanism is a new and overpowering feature. I can see no reason for these differences, as the environmental stresses seem similar.

The immature of the north-eastern species (*adscitus*, Pl. III. fig. 4), which is the cyanistic one, has the head yellowish speckled with blackish, back with dull yellow scalloping, the cheeks blue and white, the rump and under surface dull greyish blue. The mature has the head and cheeks pale yellow, the back scalloped with bright golden, the rump and underparts greyish blue. Great variability in tone is seen in the species, in some parts the blue having a greenish shade, in others a greyish, while the cheeks are parti-coloured blue and yellowish white. However, the xanthochroistic tendency seems to be increasing, as the majority of fully adult specimens have the yellow of the head encroaching on to the throat and breast, and the more colour the paler it becomes, suggesting an albinistic tendency.

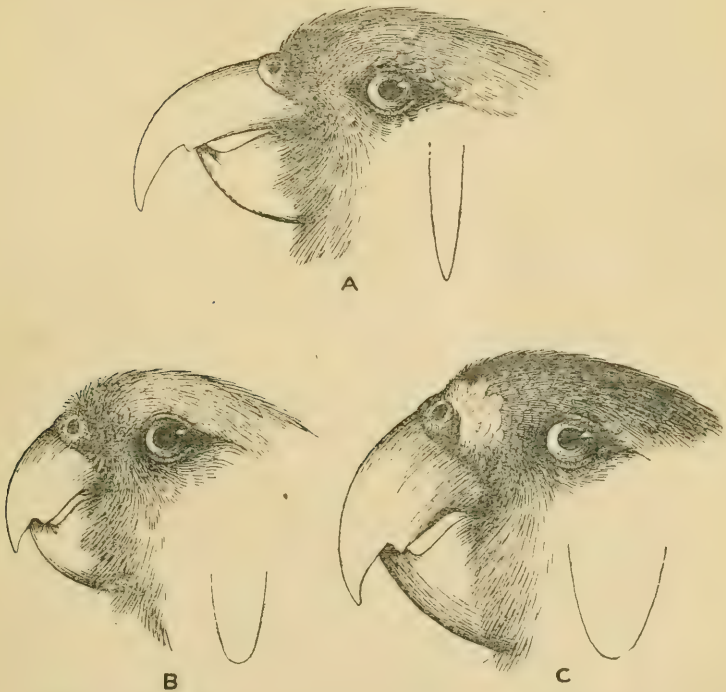
In the north-western species (*venustus*, Pl. III. fig. 8), the cyanism is entirely suppressed, being only seen in the cheeks, which are parti-coloured blue and white. The head is wholly black, the yellow-scalloped back being followed by a yellow rump, the feathers, however, are tipped with black; while the under surface is also yellow, the feathers tipped with black, and the bases black. An atavistic erythristic tendency seems to have been recorded in a red forehead and even a totally red head. The general progress appears to be strongly melanistic, the black becoming more extensive, and the yellow diminishing.

It may help in appreciating these changes to indicate in tabular form the dominating elements:—

<i>P. caledonicus</i>	Nearest ancestral, slight xanthochroism.
<i>P. flaveolus</i>	Strong xanthochroism.
<i>P. elegans</i>	Strong erythrism.
<i>P. icterotis</i>	Weaker erythrism, weak cyanism.
<i>P. eximius</i>	Strong xanthochroism, strong erythrism.
<i>P. adscitus</i>	Xanthochroism, strong cyanism.
<i>P. venustus</i>	Xanthochroism, strong melanism.

Throughout the series the colour-pattern is unchanged, although the colour itself has undergone many changes. Further, the young seem now to skip the immature plumage in some cases and in some species. Had this stage been achieved before this time, we would have had to guess at the evolution of the species, even as we now must in the case of the White Cockatoos. At the present time we have many facts, but little connection. One thing is certain, that we have here a colour-genus, though the colours are different.

Text-figure 2.



Side-view of heads and outline of frontal view of bills of—
 A. *Purpureicephalus*, B. *Platycercus*, C. *Barnardius*.

The next genus, *Barnardius* (Text-figure 2, C), is separated by the larger size of the birds and different coloration, though no striking character can be cited as regards structural

features. This genus extends over southern and south-central Australia, but not into Tasmania. Two representative species appear recognizable (*B. barnardi* and *B. zonarius*, Pl. III. fig. 9 & Text-fig. 1, *b.* & *z.*), and the variation is marked. It appears that the normal green survived more conspicuously, though cyanism seems to have been the most dominant factor; erythrism, melanism, and xanthochroism are all seen, but in subordinate features, while the peculiar scalloped back has never been produced. The evolution of the feature in *Platycercus* is inexplicable at present, and in the present genus it has never been developed, though apparently both groups are referable to allied ancestral sources.

A red forehead only appears sporadically throughout the genus, which otherwise has suppressed the erythristic element. The chief difference between the two species appears to be the possession by the western form of a wholly black head: the eastern form has the crown of the head pale green, the nape brown; in some cases the brown predominates, in others the green. Generally, however, the chief feature is the bluish shade of the green back, rump, and breast; the xanthochroistic element seems confined to a yellow band across the belly, which is variable in size, sometimes extending from the breast to the vent, at others only appearing as a spot on the abdomen. The variation in size is noteworthy and needs careful study. The species seem peculiarly plastic, as subspecies can be distinguished with ease if few specimens are examined, but more material tends to confuse the judgment, probably because the birds are wanderers to some extent and the subspecies are limited in breeding-areas.

Speculation as to the origin of these species is handicapped by the survival in the south-west of a species commonly referred to a distinct genus, *Purpureicephalus* (Pl. III. fig. 6 & Text-figure 2, A), on account of a structural difference in the bill. Otherwise it is a *Barnardius* as regards colour-pattern, the erythristic element, which has been almost entirely eliminated in that genus, having maintained itself, as the bird has a red head and is mauve underneath with red under tail-coverts. I must note that the cheek-patch, seen in the genus *Platycercus*, is present in the genus *Barnardius* in a

deeper blue shade, and is even seen in this aberrant genus as a yellow-green patch. As the immature of the genus *Purpureicephalus* shows the evolution of the mature from a green bird, we have here a case of a structural difference developing at a more rapid rate than a colour-change. We are compelled to indicate our lack of knowledge of how colour-changes and structural changes are produced, but we do know that study of colour and colour-pattern will prove even more valuable than study of structural differences.

EXPLANATION OF PLATE III.

The upper and under sides of the following Parrots:—

1. *Platycercus caledonicus.*
2. " *elegans.*
3. " *flaveolus.*
4. " *adscitus.*
5. " *eximius.*
6. *Purpureicephalus spurius.*
7. *Platycercus icterotis.*
8. " *venustus.*
9. *Barnardius zonarius.*

VII.—*Rejections by Birds of Eggs unlike their own: with Remarks on some of the Cuckoo Problems.* By C. F. M. SWYNNERTON, C.M.B.O.U.

I HAVE referred very briefly to the general result of my first season's experiments in the above connection in 'The Ibis' for October 1916 (p. 557). I returned to the attack last year, partly to ascertain whether really fine discrimination is ever shown. The experiments were interrupted while still incomplete, but Major Meiklejohn's interesting and comprehensive paper in the April 'Ibis,' just received, recalls me to the subject and suggests the publication of my summary of them. Except in the case of the first dozen experiments, I only recorded the details of such as struck me as being of somewhat special interest; but not less, I should say, than fifty were carried out in all